

Subchondroplasty

Treatment of Bone Marrow Lesions in the Lower Extremity



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KEYWORDS

• Subchondroplasty • Bone marrow edema • Bone marrow lesions • Foot and ankle

KEY POINTS

- Bone marrow lesions of the foot and ankle are challenging to treat.
- Bone marrow lesions of the foot and ankle are associated with pain, limitation of function, and cartilage loss.
- Early diagnosis and treatment of bone marrow lesions are paramount to favorable patient outcomes.
- The subchondroplasty procedure is a novel, minimally invasive technique used to treat chronic nonhealing bone marrow lesions.
- The subchondroplasty procedure is a promising treatment option for bone marrow lesions of the foot and ankle.

A bone marrow lesion (BML), originally named regional migratory osteoporosis, is a clinical syndrome characterized by pain and reduced bone density on hip radiographs in the third trimester of pregnancy.¹ It was initially described in 1959 by Curtiss and Kincaid.² Since then, various terminology has been used to describe this clinical finding, such as transient osteoporosis of the hip, regional migratory osteoporosis, and reflex sympathetic dystrophy.

The term bone marrow edema (BME) was proposed by Hofmann and colleagues³ in 2008 as a general term based on common MRI findings. Regardless of cause, BME presents as a nonspecific area of low signal intensity on T1-weighted MRI and intermediate or high signal intensity on T2-weighted MRI.⁴

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The cause underlying BME remains largely unknown. Recent histologic analysis of these lesions show an absence of edematous changes in many of these cases, which led to the adoption of the term BML.⁵ Histologically, the lesions are characterized by fibrosis, lymphocytic infiltrates and increased vascularization. It is likely this increased vascularization is responsible for the water signal on MRI. BMLs have been associated with a variety of inflammatory and noninflammatory conditions, including trauma, osteoarthritis, inflammatory arthropathies, ischemia, infection, metabolic disorders, and neoplasms. In both inflammatory and noninflammatory conditions, the presence of BMLs is usually associated with pain, progression of disease, and cartilage loss.⁶

The presence of BMLs has been related to mechanical loading and increased subchondral stress, particularly in the hip, knee, ankle, and foot.⁶ In 2001, Felson and colleagues^{7,8} became the first to correlate BML with pain and subsequent osteoarthritis in the knee. In the MRI study, 77.5% of subjects with knee pain had BMLs deep to the subchondral bone.

Treatment of osteochondral lesions of the foot and ankle has proven to be challenging. For osteochondritis dissecans lesions of the talus, the standard of treatment has been arthroscopic interventions, which include retrograde drilling, bone marrow stimulation, and osteochondral autograft transportation. More recent techniques include cartilage autografts, such as autologous chondrocyte implantation, matrix-associated autologous chondrocyte implantation, and allograft tissues such as juvenile allograft cartilage.⁹⁻¹²

The subchondroplasty (SCP) procedure, developed in 2007, is a minimally invasive technique that uses an orthobiologic to treat chronic nonhealing BMLs. It is performed by injecting a flowable, synthetic, nanocrystalline calcium phosphate (CaP) bone filler into the region of the BML defect, using fluoroscopy as a guide.¹³ When the CaP is injected, an endothermic reaction crystallizes the CaP to mimic the properties of healthy cancellous bone. This technique allows the CaP to be injected between subchondral cancellous trabeculae without damaging the existing bone scaffold.¹⁴ SCP can be performed in conjunction with arthroscopy to improve accuracy of the desired injection location and to correct any intraarticular pathologic conditions. The goal of this procedure is to improve the integrity of the damaged subchondral bone and allow for remodeling back into healthy cancellous bone.¹³

Not many studies of the efficacy of SCP have been performed, particularly in the foot and ankle. Most of the literature has been in regard to the knee. Sharkey and Cohen¹³ reported pain improvement in visual analog scale (VAS) scores by 4.3 points in 50 out of 57 subjects at 6-month follow-up of SCP of the knee. Bonadio and colleagues¹⁴ performed SCP in 5 cases in the distal medial femoral condyle and the medial tibial plateau, all of which had VAS assessment drop from a mean of 7.8 preoperatively to a mean of 2.2 postoperatively at 24 weeks after surgery. Miller and Dunn¹⁵ performed SCP of the ankle joint on 2 subjects, who both admit to having minimal pain of the ankle 10 months after surgery.

Though SCP has been primarily described in the lower extremity as being performed in the knee and talus, it can essentially be performed in any osseous structure of the foot with a symptomatic BML. In the authors' practices, SCP has been successfully performed in osseous structures of the rearfoot, midtarsus, and lesser tarsus.

Preoperatively, the patient presents with localized pain that has been unresponsive to conservative therapy, including offloading and short courses of antiinflammatory

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